MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY

A FINE RESOLUTION MODEL OF THE LEEUWIN CURRENT SYSTEM OFF WESTERN AND SOUTHERN AUSTRALIA

Robyn L. Phillips-Lieutenant, Royal Australian Navy
B.Sc., University of New South Wales, 1993
Master of Science in Physical Oceanography-September 2002
Advisor: Mary L. Batteen, Department of Oceanography
Second Reader: Curtis A. Collins, Department of Oceanography

To investigate the role of wind forcing, bottom topography and thermohaline gradients in the Leeuwin Current System (LCS) off western and southern Australia, several experiments are conducted with a sigma coordinate primitive equation model on a beta-plane. Results show that off the west (southern) coast the LCS is an anomalous eastern boundary current system that generates a coastal poleward (eastward) current, an equatorward (westward) undercurrent, and highly energetic mesoscale features such as meanders and eddies. Off the west coast, thermohaline forcing, wind forcing and bottom topography all play important roles: Thermohaline gradient effects are shown to be the primary mechanism in the generation of the poleward current, equatorward undercurrent, eddies and meanders. Inshore of the poleward surface flow, next to the coast, wind forcing also plays an important role in generating an equatorward coastal current and upwelling. Bottom topography is responsible for strengthening and trapping currents near the coast, intensifying eddies off capes and in preventing the undercurrent from becoming the dominant surface flow. Bottom topography is also shown to play a dominant role off the southern coast in trapping the eastward Leeuwin Current and the westward Flinders Current over the shelf break and slope, respectively. Overall, the results of the study compare well with available observations and previous studies of the LCS.

KEYWORDS: Primitive Equation Model, Leeuwin Current System, Great Australian Bight, Currents, Sigma-level, Princeton Ocean Model (POM), Flinders Current

ASSESSMENT OF DELFT3D MORPHODYNAMIC MODEL DURING DUCK94

Charlotte A. Welsch-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Science in Physical Oceanography-September 2002
Advisor: Edward B. Thornton, Department of Oceanography
Co-advisor: Ad Reniers, National Research Council Research Associate

Cross-shore wave transformation, nearshore currents, and morphology model predictions using Delft3D are compared with comprehensive observations acquired on a barred beach at Duck, North Carolina over a wide range of conditions. The Delft3D 2-DH model utilizes shallow water equations to phase resolve the mean and infragravity motions in combination with an advection diffusion equation for the sediment transport. Model coefficients and the effect of small changes in the wave incidence angle were examined for model sensitivity. The wave transformation model is dependent on the breaking parameter g , which determines organized wave energy dissipation. g was found to increase as a function of offshore H_{rms}. However, this is robust and a model skill of .89 was obtained using a constant g = .425. The manning number n affects the current bed shear stress and determines the model current magnitude having an optimal value of n = 0.2. The model is not overly sensitive to the value of n. The asymmetry coefficient a_w determines the amount of onshore sediment movement. The rip channel created by mean currents on a short time scale is not affected by a_w whereas bar evolution requires more time to develop allowing a_w

to affect morphology. A values of a_w = .25 gave the best results. Further research is needed to calibrate this parameter. Small changes in wave angle can cause significant errors for currents when complex bathymetry is present and the waves are near shore normal. Overall the model is robust with sensitivity to small changes in near normal wave angles.

KEYWORDS: Delft3D, Sediment Transport, Alongshore Current, Duck94, Wave Asymmetry, Nearshore Modeling, Wave Breaking Parameter, Infragravity Waves